

# Appendix A

# Peter Arcidiacono

## Demonstratives

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*STUDENTS FOR FAIR ADMISSIONS, INC.*

v.

*UNIVERSITY OF NORTH CAROLINA, et al.*

IN THE UNITED STATES DISTRICT COURT  
FOR THE MIDDLE DISTRICT OF NORTH CAROLINA  
CASE NO. 1:14-CV-00954-LCB-JLW

# Applicant Datasets (2016-2021)

	In-State Applicants	Out-of-State Applicants	In-State + Out-of-State
Initial Observations	65,123	135,289	200,412
	In-State Removed	Out-of-State Removed	IS + OS Removed
Withdrawal, Incomplete	2,840 (4.4%)	7,772 (5.7%)	10,612
Any Rating Zero	315 (0.5%)	382 (0.3%)	697
Any Special	4,590 (7.0%)	4,273 (3.2%)	8,863
Foreign	153 (0.2%)	17,230 (12.7%)	17,383
Total Removed	7,898 (12.1%)	29,657 (21.9%)	37,555
Total Remaining	57,225	105,632	162,857

NOTE: Percentages denote the number of observations cut as a percentage of the initial number of observations.

UNC's Overall Acceptance Rate = 25.61%

Out-of-State Acceptance Rate = 13.52%

In-State Acceptance Rate = 47.92%

3.5x



# Admission Rates by Race and Residency

	White	Asian American	African American	Hispanic
In-State Admission Rate	50.86%	53.56%	30.53%	40.96%
Out-of-State Admission Rate	10.91%	16.60%	16.74%	20.18%

# Application Summary Statistics by Race: In-State Applicants (2016-2021)

	White			Asian American			African American			Hispanic		
	Reject	Admit	All	Reject	Admit	All	Reject	Admit	All	Reject	Admit	All
Female	56.93	60.67	58.83	55.83	56.97	56.44	65.91	70.09	67.19	62.25	61.22	61.83
First-generation college	18.25	13.21	15.69	30.03	20.04	24.68	41.68	33.57	39.20	51.06	40.48	46.73
Legacy	17.42	21.84	19.67	4.62	5.77	5.24	6.35	9.27	7.24	4.53	4.90	4.68
Waiver	6.92	5.06	5.97	16.26	12.19	14.08	45.86	37.99	43.46	36.01	28.91	33.10
SAT math (z-score)	-0.69	0.06	-0.31	-0.46	0.47	0.04	-1.57	-0.73	-1.31	-1.17	-0.37	-0.84
SAT verbal (z-score)	-0.55	0.25	-0.14	-0.74	0.27	-0.20	-1.42	-0.51	-1.14	-1.03	-0.16	-0.68
High school class percentile (0-100)	79.10	93.58	86.34	74.86	92.78	83.94	74.20	91.56	79.26	74.87	91.81	81.57
GPA (z-score)	-0.09	0.90	0.41	-0.14	1.03	0.49	-0.67	0.59	-0.28	-0.39	0.74	0.07
Program Rating (1-10)	5.35	7.52	6.45	6.35	8.56	7.53	4.94	7.30	5.66	5.34	7.42	6.19
Performance Rating (1-10)	5.62	8.37	7.02	4.96	8.03	6.60	4.55	7.40	5.42	4.93	7.77	6.09
Extracurricular Rating (1-10)	5.42	6.07	5.75	5.09	6.02	5.59	4.90	5.69	5.15	5.00	5.71	5.29
Essay Rating > 5	0.05	0.15	0.10	0.05	0.19	0.13	0.03	0.13	0.06	0.04	0.14	0.08
Personal Quality Rating > 5	0.11	0.24	0.18	0.11	0.27	0.20	0.14	0.32	0.20	0.17	0.32	0.23
N	18229	18865	37094	2794	3223	6017	5401	2374	7775	2119	1470	3589

NOTE: Essay and Personal Quality are given across the set (1, 3, 5, 7, 10) though five is by far the most common score.

# Application Summary Statistics by Race: Out-of-State Applicants (2016-2021)

	White			Asian American			African American			Hispanic		
	Reject	Admit	All	Reject	Admit	All	Reject	Admit	All	Reject	Admit	All
Female	61.18	55.26	60.53	55.73	54.74	55.56	66.00	66.79	66.13	59.26	60.35	59.48
First-generation college	8.97	7.22	8.78	13.37	8.90	12.63	29.75	19.00	27.95	23.97	14.94	22.14
Legacy	2.63	17.82	4.29	0.80	3.00	1.16	1.78	3.80	2.12	1.25	4.34	1.87
Waiver	3.70	2.63	3.58	9.92	6.63	9.37	36.39	25.67	34.60	18.54	12.63	17.35
SAT math (z-score)	-0.01	0.80	0.08	0.48	1.20	0.60	-1.16	-0.08	-0.98	-0.43	0.40	-0.27
SAT verbal (z-score)	0.15	1.02	0.24	0.22	1.17	0.38	-0.91	0.24	-0.72	-0.25	0.64	-0.07
High school class percentile (0-100)	87.49	96.75	88.44	86.78	97.14	88.53	77.18	94.01	79.88	83.34	95.34	85.57
GPA (z-score)	-0.16	0.29	-0.11	-0.16	0.34	-0.07	-0.70	0.07	-0.57	-0.21	0.37	-0.09
Program Rating (1-10)	6.16	8.40	6.40	7.26	9.10	7.57	5.08	7.65	5.51	6.26	8.42	6.70
Performance Rating (1-10)	7.32	9.08	7.51	6.85	9.06	7.22	5.29	8.01	5.75	6.35	8.58	6.80
Extracurricular Rating (1-10)	5.87	6.83	5.98	5.81	7.02	6.01	5.24	6.29	5.41	5.57	6.50	5.76
Essay Rating > 5	0.11	0.44	0.15	0.14	0.50	0.20	0.08	0.30	0.12	0.10	0.35	0.15
Personal Quality Rating > 5	0.16	0.53	0.20	0.17	0.56	0.24	0.19	0.51	0.24	0.20	0.50	0.27
N	56790	6954	63744	13554	2698	16252	7980	1605	9585	7202	1821	9023

NOTE: Essay and Personal Quality are given across the set (1, 3, 5, 7, 10) though five is by far the most common score.

## Academic Index

$$AI = SAT^* + GPA^*$$

\* z-score



In-State & Out-of-State Admit Rates: Full Sample vs. Decile Sample

In-State	White	Asian American	African American	Hispanic
Full Sample	50.86%	53.56%	30.53%	40.96%
Decile Sample	50.66%	52.87%	30.25%	40.93%

Out-of-State	White	Asian American	African American	Hispanic
Full Sample	10.91%	16.60%	16.74%	20.18%
Decile Sample	10.56%	16.16%	16.67%	19.64%

# In-State Applicants: Share Above Median Rating by Academic Index Decile

Academic Decile	Program	Performance	Activities	Essay	Personal Qualities
10	88.70%	84.40%	40.40%	22.20%	28.70%
9	74.60%	70.50%	32.10%	15.50%	22.50%
8	65.20%	61.50%	26.70%	12.90%	21.00%
7	57.90%	51.30%	24.50%	10.60%	19.70%
6	50.10%	40.80%	22.10%	9.30%	17.90%
5	43.20%	31.80%	20.40%	8.90%	17.70%
4	36.30%	21.70%	18.30%	6.50%	15.80%
3	31.30%	14.10%	15.60%	5.20%	14.50%
2	22.60%	7.70%	12.60%	3.70%	13.10%
1	15.00%	1.80%	8.40%	2.00%	11.00%

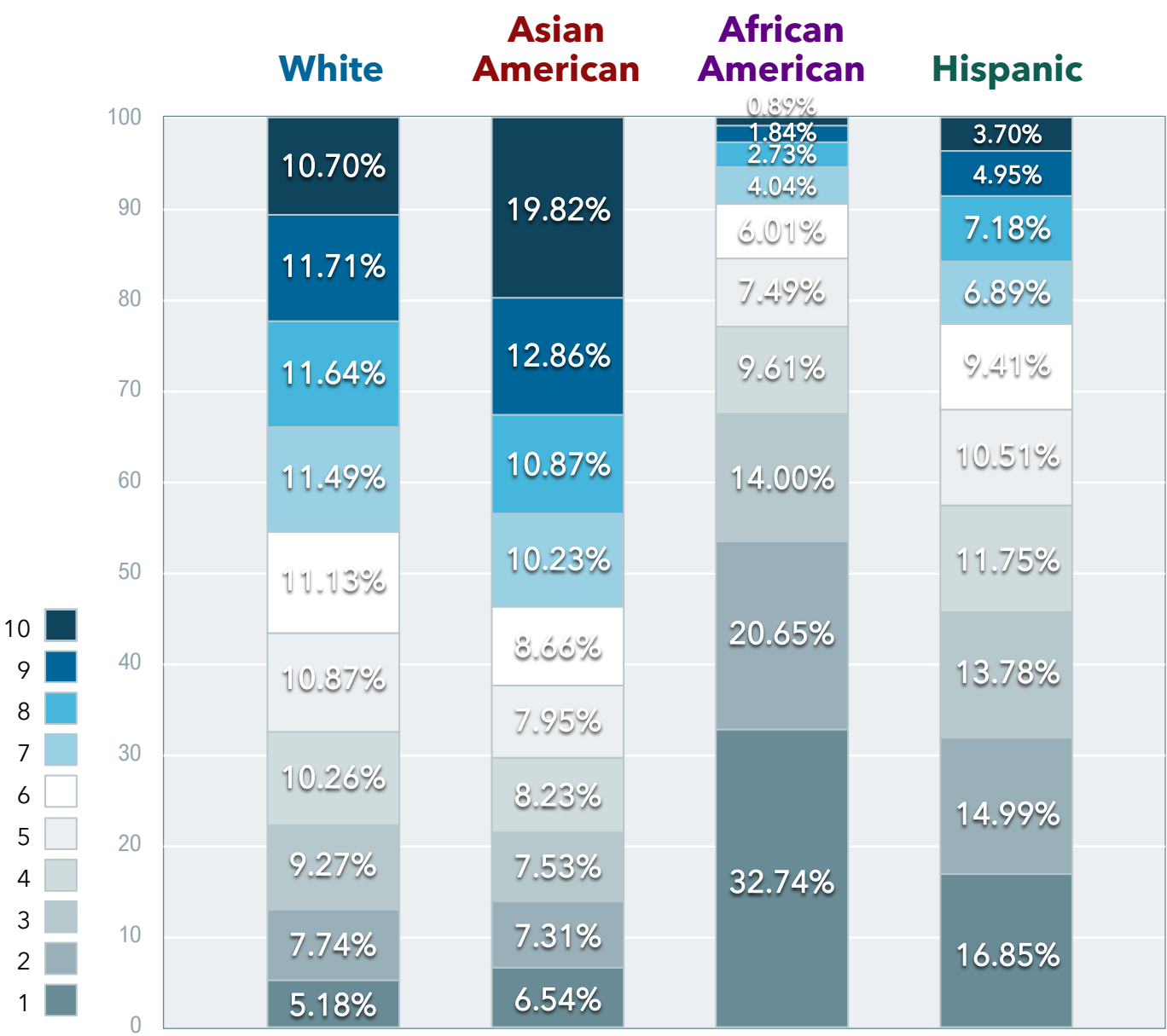
# Out-of-State Applicants: Share Above Median Rating by Academic Index Decile

Academic Decile	Program	Performance	Activities	Essay	Personal Qualities
10	85.90%	82.10%	47.20%	29.70%	35.30%
9	79.00%	74.80%	41.80%	24.10%	30.20%
8	72.00%	68.60%	38.20%	20.20%	26.90%
7	64.80%	62.90%	34.30%	18.00%	23.40%
6	56.40%	54.40%	31.40%	14.90%	20.60%
5	48.20%	47.50%	28.00%	13.00%	18.30%
4	40.70%	38.40%	25.60%	10.30%	16.60%
3	34.00%	26.60%	21.10%	8.40%	14.70%
2	25.60%	15.50%	18.10%	6.80%	13.10%
1	15.30%	3.90%	12.50%	3.40%	11.30%

In-State Applicants in Each Academic Index Decile

Academic Decile	White	Asian American	African American	Hispanic
10	3820	1139	67	128
9	4180	739	138	171
8	4153	625	205	248
7	4101	588	304	238
6	3972	498	452	325
5	3880	457	563	363
4	3663	473	723	406
3	3310	433	1053	476
2	2762	420	1553	518
1	1848	376	2462	582
Total	35689	5748	7520	3455

Percentage of In-State Applicants in Each Academic Index Decile



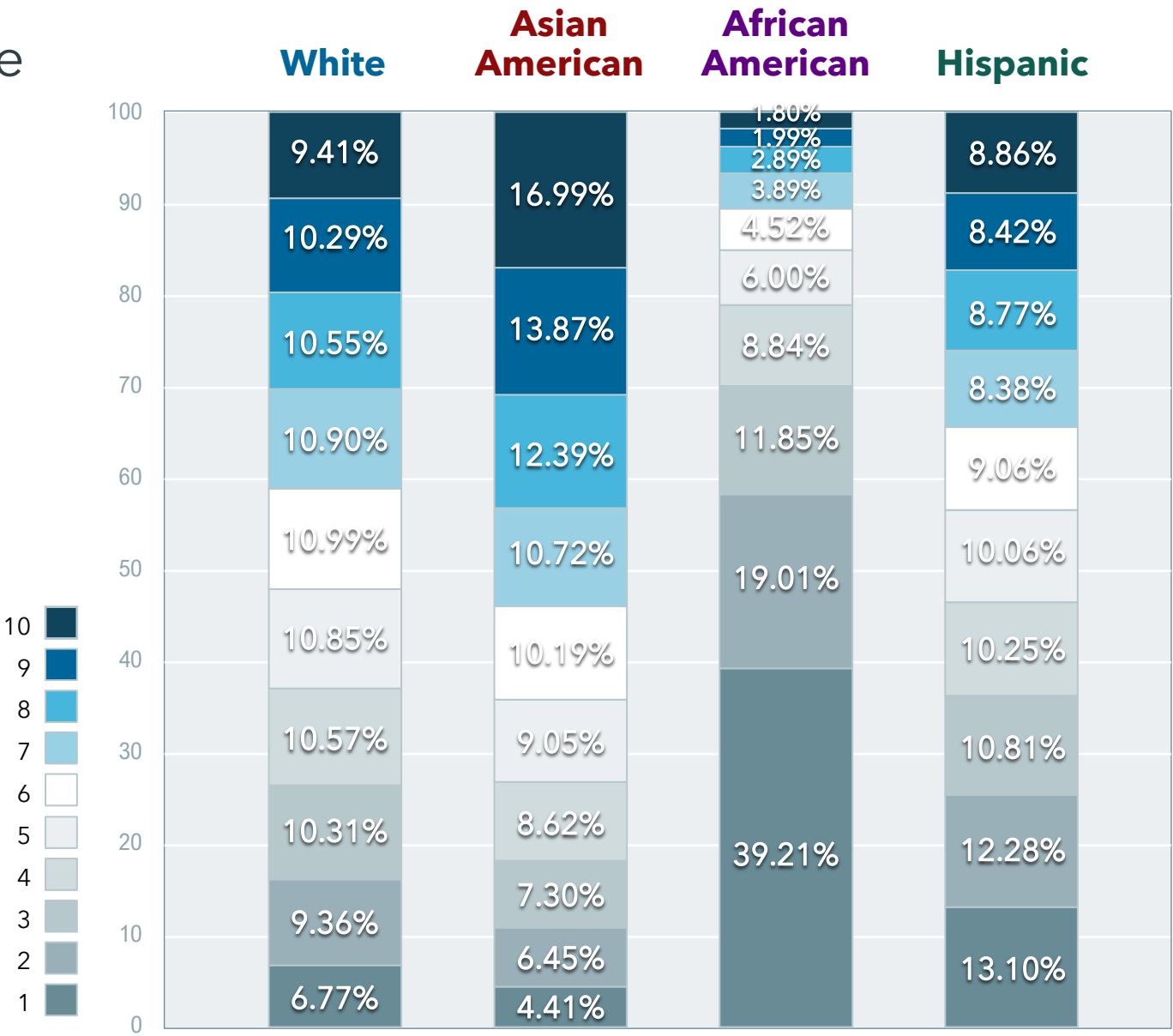
# In-State Admission Rates by Academic Index Decile and Race/Ethnicity

Academic Decile	White	Asian American	African American	Hispanic	All Applicants	
10	98.85%	98.16%	97.01%	98.44%	98.66%	
9	94.07%	88.36%	97.10%	96.49%	93.42%	+ 5.24%
8	84.08%	74.40%	94.63%	87.50%	83.50%	+ 9.93%
7	69.40%	56.97%	88.49%	81.09%	69.64%	+ 13.86%
6	47.31%	44.38%	80.09%	67.69%	51.11%	+ 18.53%
5	29.56%	28.67%	71.23%	53.72%	35.61%	+ 15.50%
4	17.83%	16.91%	49.24%	38.42%	23.65%	+ 11.96%
3	7.76%	6.24%	28.77%	22.48%	13.16%	+ 10.49%
2	3.08%	1.90%	10.69%	5.21%	5.44%	+ 7.72%
1	0.70%	0.27%	1.02%	1.37%	0.89%	+ 4.55%
TOTAL	50.66%	52.87%	30.25%	40.93%	47.33%	

# Out-of-State Applicants in Each Academic Index Decile

Academic Decile	White	Asian American	African American	Hispanic
10	4216	1900	123	568
9	4610	1551	136	540
8	4727	1386	197	562
7	4883	1199	265	537
6	4926	1140	308	581
5	4860	1012	409	645
4	4737	964	603	657
3	4618	816	808	693
2	4195	721	1296	787
1	3033	493	2674	840
Total	44805	11182	6819	6410

# Percentage of Out-of-State Applicants in Each Academic Index Decile





# Out-of-State Admission Rates by Academic Index Decile and Race/Ethnicity

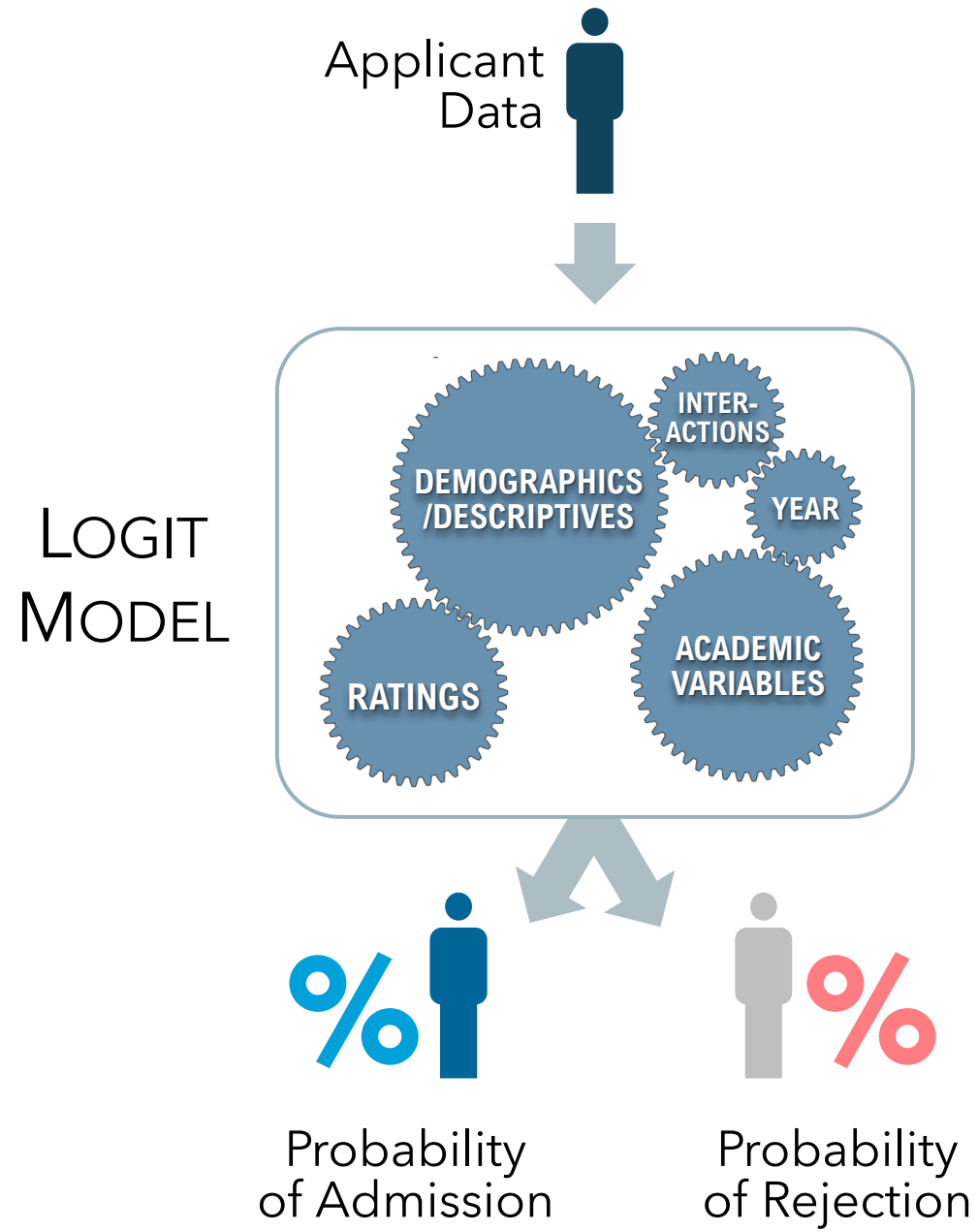
Academic Decile	White	Asian American	African American	Hispanic	All Applicants	
10	41.58%	52.89%	73.17%	61.44%	46.97%	
9	26.51%	27.66%	69.12%	42.41%	28.87%	+ 18.10%
8	15.87%	15.51%	57.87%	33.63%	18.45%	+ 10.42%
7	9.24%	6.51%	57.74%	30.35%	12.27%	+ 6.18%
6	5.34%	4.56%	46.10%	22.20%	8.43%	+ 3.84%
5	2.90%	1.38%	39.61%	15.97%	6.06%	+ 2.37%
4	1.52%	1.04%	29.85%	9.28%	4.64%	+ 1.42%
3	0.89%	0.25%	14.36%	3.61%	2.65%	+ 1.99%
2	0.52%	0.28%	5.71%	1.27%	1.54%	+ 1.11%
1	0.49%	0.00%	0.45%	0.12%	0.40%	+ 1.14%
TOTAL	10.56%	16.16%	16.67%	19.64%	12.91%	

Number and Share of In-State Admits  
Under Admission from Top Academic Deciles

	White		Asian American		African American		Hispanic	
	Admit	Share	Admits	Share	Admit	Share	Admit	Share
Actual	18080	72.9%	3039	12.3%	2275	9.2%	1414	5.7%
Admission from Top Deciles	19255	77.6%	3467	14.0%	1055	4.3%	1031	4.2%

Number and Share of Out-of-State Admits  
Under Admission from Top Academic Deciles

	White		Asian American		African American		Hispanic	
	Admit	Share	Admits	Share	Admit	Share	Admit	Share
Actual	4730	52.9%	1807	20.2%	1137	12.7%	1259	14.1%
Admission from Top Deciles	5650	63.2%	2382	26.7%	165	1.9%	736	8.2%



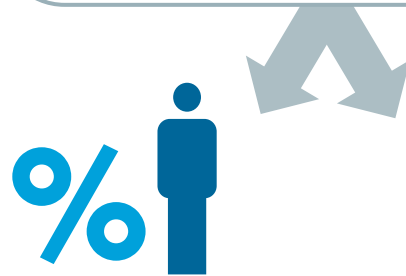
Applicant  
Data



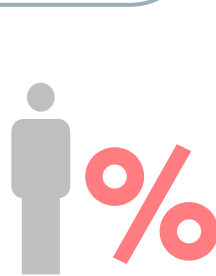
LOGIT MODEL  $\approx$   
UNC PROCESS



$a$ \*Prog +  $b$ \*Perf +  $c$ \*Activ +  $d$ \*Essay ... +  $R$ \*Race



Probability  
of Admission



Probability  
of Rejection

# Gratz: University of Michigan Points System

VARIABLE	POINTS
Academic Achievement:    GPA + Standardized Test Score + Academic Quality of Applicant’s High School + Strength or Weakness of Applicant’s Curriculum	Up to 110
MI Residency	10
Personal Achievement	5
Outstanding Essay	1-3
Leadership + Service	1-5
Legacy	1-4
Under-Represented Minority*	20
Attendance at a socioeconomic or predominantly minority high school*	20
Recruited Athlete*	20
Provost’s Discretion*	20

\*Applicants can only receive 20 points for one of these categories

SCORE RANGE	ADMISSIONS DECISION
100-150	Admit
95-99	Admit or Postpone
90-94	Postpone or Admit
75-89	Delay or Postpone
74 and Below	Delay or Reject

# Controls Used for Opening Report Models of UNC Admissions

CONTROLS	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	MODEL 6	MODEL 7
Race/ethnicity	●	●	●	●	●	●	●
Female	●	●	●	●	●	●	●
Early or regular decision	●	●	●	●	●	●	●
Alum	●	●	●	●	●	●	●
First generation	●	●	●	●	●	●	●
Fee waiver	●	●	●	●	●	●	●
Missing fee waiver	●	●	●	●	●	●	●
Year indicators	●	●	●	●	●	●	●
SAT math		●	●	●	●	●	●
SAT verbal		●	●	●	●	●	●
Missing SAT times race/ethnicity		●	●	●	●	●	●
GPA		●	●	●	●	●	●
Missing GPA times race/ethnicity		●	●	●	●	●	●
Percentile		●	●	●	●	●	●
Percentile times non-standard rank type		●	●	●	●	●	●
Missing percentile times year		●	●	●	●	●	●
Race/ethnicity		●	●	●	●	●	●
Non-standard rank type		●	●	●	●	●	●
Non-standard rank type times race/ethnicity		●	●	●	●	●	●
Indicators for different ways of imputing SAT		●	●	●	●	●	●
UNC program score			●	●	●	●	●
UNC performance score			●	●	●	●	●
UNC activity score			●	●	●	●	●
UNC essay score			●	●	●	●	●
UNC personal quality score			●	●	●	●	●
Intended college major				●	●	●	●
Female interacted with race/ethnicity				●	●	●	●
First-generation interacted with race/ethnicity				●	●	●	●
High schools w/ min. number of applications and admits					●	●	●
High school fixed effects						●	●
Census tract data w/ min. number of applications and admits*							●

\* In-State Models Only

# Interactions

Variable	Coefficient
African American	<b>A</b>
FGC	<b>F</b>
African American and FGC	<b>X</b>

FGC African American [vs. FGC White] = **A** + **X**

FGC African American [vs. Not FGC African American] = **F** + **X**

FGC African American [vs. Not FGC White] = **A** + **F** + **X**



# Controls Used for Updated Models of UNC Admissions

CONTROLS	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	MODEL 6	MODEL 7
Race/ethnicity	•	•	•	•	•	•	•
Female	•	•	•	•	•	•	•
Early or regular decision	•	•	•	•	•	•	•
Alum	•	•	•	•	•	•	•
First generation	•	•	•	•	•	•	•
Fee waiver	•	•	•	•	•	•	•
Missing fee waiver	•	•	•	•	•	•	•
Year indicators	•	•	•	•	•	•	•
<b>Faculty child</b>	•	•	•	•	•	•	•
SAT math		•	•	•	•	•	•
SAT verbal		•	•	•	•	•	•
Missing SAT times race/ethnicity		•	•	•	•	•	•
GPA		•	•	•	•	•	•
Missing GPA times race/ethnicity		•	•	•	•	•	•
Percentile		•	•	•	•	•	•
Percentile times non-standard rank type		•	•	•	•	•	•
Missing percentile times year		•	•	•	•	•	•
Race/ethnicity		•	•	•	•	•	•
Non-standard rank type		•	•	•	•	•	•
Non-standard rank type times race/ethnicity		•	•	•	•	•	•
Indicators for different ways of imputing SAT		•	•	•	•	•	•
<b>Rank within applicants from same high school</b>		•	•	•	•	•	•
<b>Rank within applicants from same high school missing</b>		•	•	•	•	•	•
<b>Met minimum admission requirements</b>		•	•	•	•	•	•
UNC program score			•	•	•	•	•
UNC performance score			•	•	•	•	•
UNC activity score			•	•	•	•	•
UNC essay score			•	•	•	•	•
UNC personal quality score			•	•	•	•	•
Intended college major				•	•	•	•
Female interacted with race/ethnicity				•	•	•	•
First-generation interacted with race/ethnicity				•	•	•	•
High schools w/ min. number of applications and admits					•	•	•
High school fixed effects						•	•
Census tract data w/ min. number of applications and admits*							•

\* In-State Models Only

# Logit Estimates of In-State Admissions, 2016-2021

Variable	Spec1	Spec2	Spec3	Spec4
African American	<b>-0.589</b> (0.029)	<b>1.851</b> (0.057)	<b>2.863</b> (0.073)	<b>3.542</b> (0.119)
Hispanic	<b>-0.131</b> (0.038)	<b>1.240</b> (0.070)	<b>1.771</b> (0.09)	<b>1.993</b> (0.15)
Asian American	<b>0.235</b> (0.029)	<b>-0.133</b> (0.057)	<b>-0.011</b> (0.07)	<b>0.148</b> (0.10)
Female	<b>0.104</b> (0.018)	<b>0.198</b> (0.031)	<b>0.035</b> (0.04)	<b>0.112</b> (0.05)
FGC	<b>-0.304</b> (0.024)	<b>0.647</b> (0.04)	<b>0.926</b> (0.05)	<b>1.168</b> (0.06)
Alum	<b>0.193</b> (0.025)	<b>0.380</b> (0.04)	<b>0.447</b> (0.05)	<b>0.467</b> (0.05)
<b>FEMALE * RACE</b>				
African American				<b>-0.469</b> (0.12)
Hispanic				<b>-0.166</b> (0.15)
Asian American				<b>-0.247</b> (0.12)
<b>FGC * RACE</b>				
African American				<b>-1.027</b> (0.12)
Hispanic				<b>-0.392</b> (0.16)
Asian American				<b>-0.148</b> (0.14)
Academic Variables		<b>X</b>	<b>X</b>	<b>X</b>
Ratings Variables			<b>X</b>	<b>X</b>
Heterogeneity Variables				<b>X</b>
N	<b>57,225</b>	<b>57,225</b>	<b>57,225</b>	<b>57,225</b>
Pseudo R-squared	0.0564	0.588	0.725	0.727

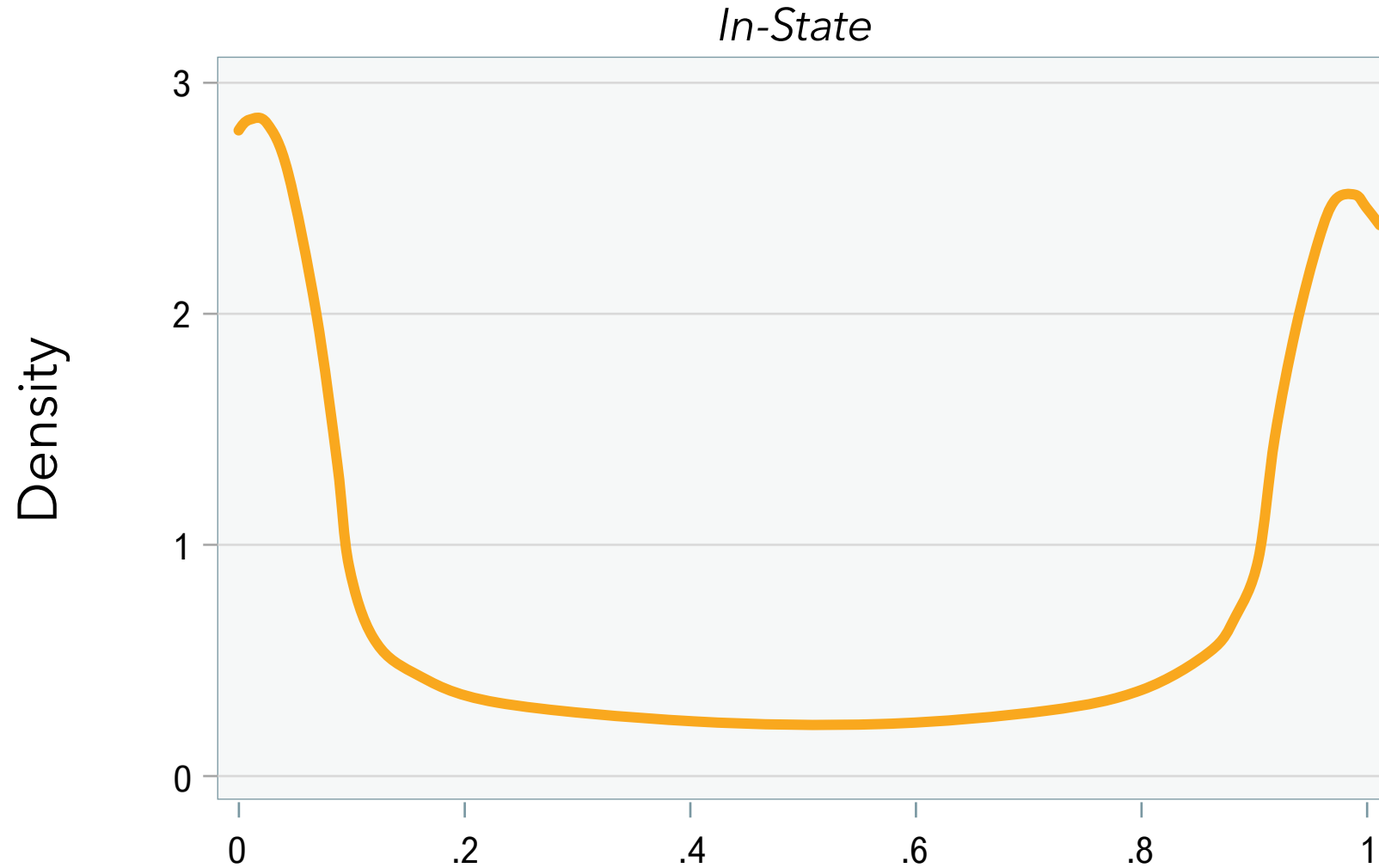
# Logit Estimates of Out-of-State Admissions, 2016-2021

Variable	Spec1	Spec2	Spec3	Spec4
African American	<b>0.866</b> (0.033)	<b>4.766</b> (0.077)	<b>5.934</b> (0.095)	<b>6.162</b> (0.125)
Hispanic	<b>0.98</b> (0.031)	<b>2.484</b> (0.071)	<b>3.054</b> (0.083)	<b>3.000</b> (0.104)
Asian American	<b>0.781</b> (0.026)	<b>0.196</b> (0.055)	<b>0.09</b> (0.065)	<b>0.077</b> (0.079)
Female	<b>-0.157</b> (0.019)	<b>0.333</b> (0.025)	<b>0.032</b> (0.030)	<b>-0.075</b> (0.040)
FGC	<b>-0.172</b> (0.033)	<b>0.912</b> (0.044)	<b>1.367</b> (0.052)	<b>1.889</b> (0.075)
Alum	<b>1.866</b> (0.037)	<b>3.412</b> (0.055)	<b>4.741</b> (0.071)	<b>4.769</b> (0.072)
<b>FEMALE * RACE</b>				
African American				<b>0.081</b> (0.107)
Hispanic				<b>0.357</b> (0.094)
Asian American				<b>0.107</b> (0.075)
<b>FGC * RACE</b>				
African American				<b>-1.343</b> (0.136)
Hispanic				<b>-0.986</b> (0.136)
Asian American				<b>-0.554</b> (0.130)
Academic Variables		<b>X</b>	<b>X</b>	<b>X</b>
Ratings Variables			<b>X</b>	<b>X</b>
Heterogeneity Variables				<b>X</b>
<b>N</b>	<b>105,623</b>	<b>105,623</b>	<b>105,137</b>	<b>105,116</b>
<b>Pseudo R-squared</b>	0.0727	0.42	0.586	0.588

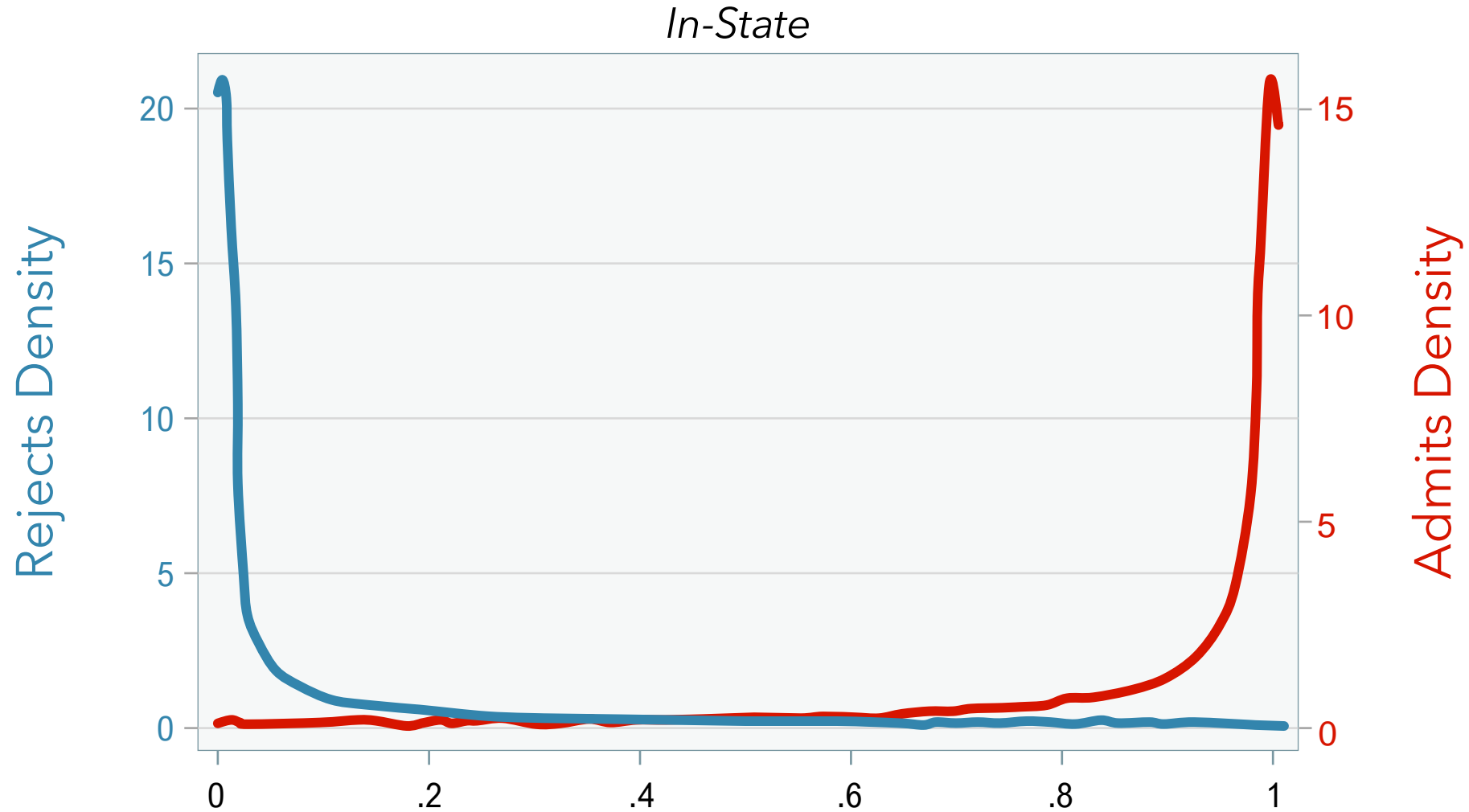
# Accuracy of My Preferred Model for In-State Admissions

	Accuracy for Admits	Accuracy for Rejects	Overall Accuracy
Preferred Model	91.8%	92.5%	92.1%
Model with No Controls	48.1%	52.2%	50.2%

# Distribution of Predicted Admit Probabilities for In-State Applicants



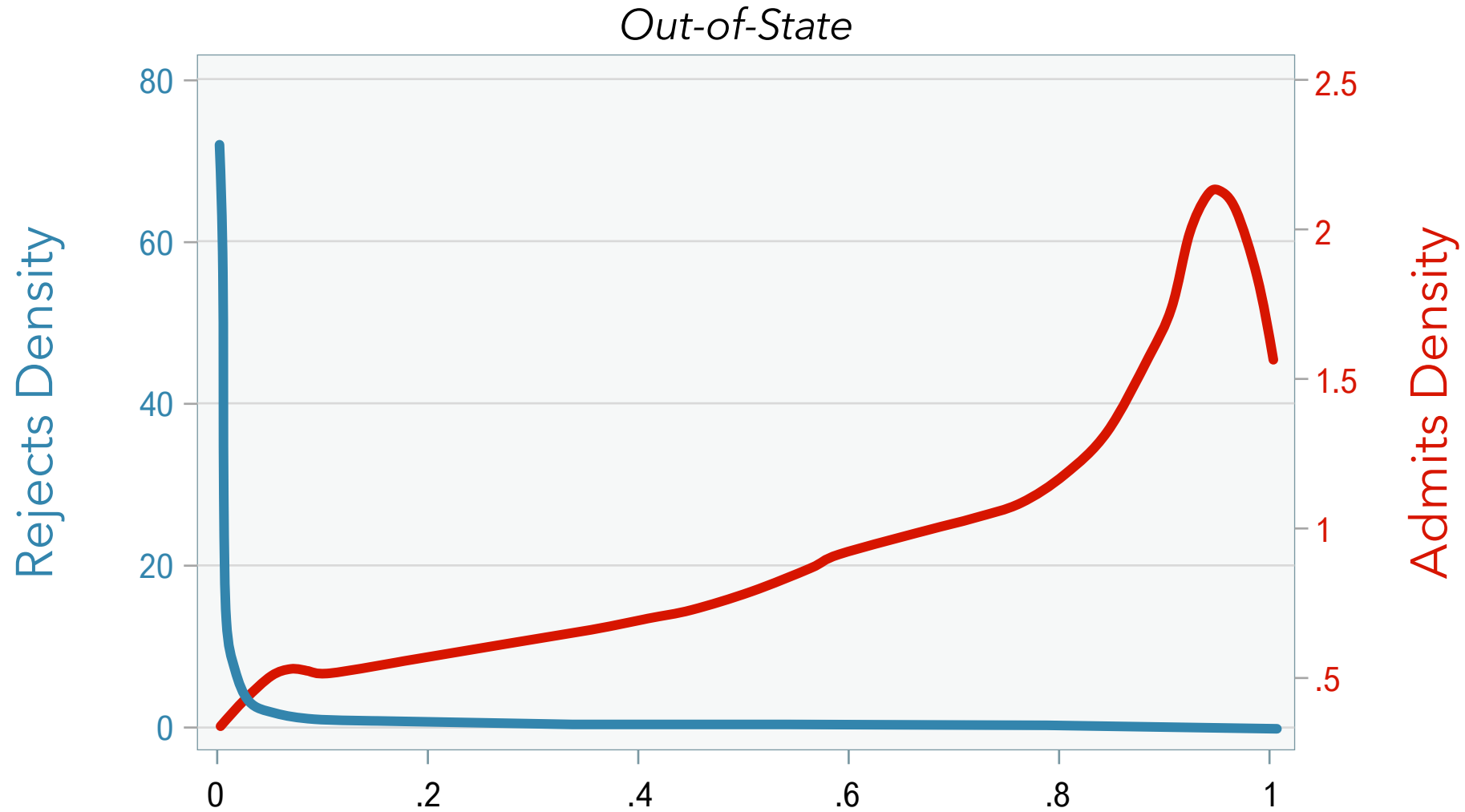
# Distribution of Predicted Admit Probabilities Conditional on Being Rejected or Admitted for In-State Applicants



# Accuracy of My Preferred Model for Out-of-State Admissions

	Accuracy for Admits	Accuracy for Rejects	Overall Accuracy
Preferred Model	75.4%	96.1%	93.3%
Model with No Controls	13.9%	86.5%	76.7%

# Distribution of Predicted Admit Probabilities Conditional on Being Rejected or Admitted for Out-of-State Applicants





# Quantifying the Effect of UNC's Racial Preferences

Transformational Analysis	
Average Marginal Effect	
Admitted URM's Analysis	
Capacity Constraints Analysis	

# Transformational Analysis Methodology

- Consider someone with characteristics that would give them a 25% chance of being admitted.
- The admissions index according to the implicit formula,  $A$ , is given by:

$$\frac{\exp(A)}{1+\exp(A)} = 0.25$$

- In this case,  $A = -1.098$
- We add to this the racial bump given by the coefficients of the model.
- For example, for an in-state white male who is not FGC, we can just add the African American coefficient: 3.542
- So if this applicant was treated as African American, his new admit probability would be:

$$\frac{\exp(-1.098+3.542)}{1+\exp(-1.098+3.542)} = 0.92$$


# Transformational Analysis: Changing the Race of an Individual In-State Applicant

	Original Admit Probability	Admission probability if treated as <b>African American</b>	Admission probability if treated as <b>Hispanic</b>
<b>White</b> , Male, not FGC	10%	79.33%	44.92%
	25%	92.01%	70.98%
<b>White</b> , Female, not FGC	10%	70.59%	40.86%
	25%	87.80%	67.45%
<b>White</b> , Male, FGC	10%	57.88%	35.52%
	25%	80.48%	62.30%
<b>White</b> , Female FGC	10%	46.21%	31.81%
	25%	72.05%	58.33%

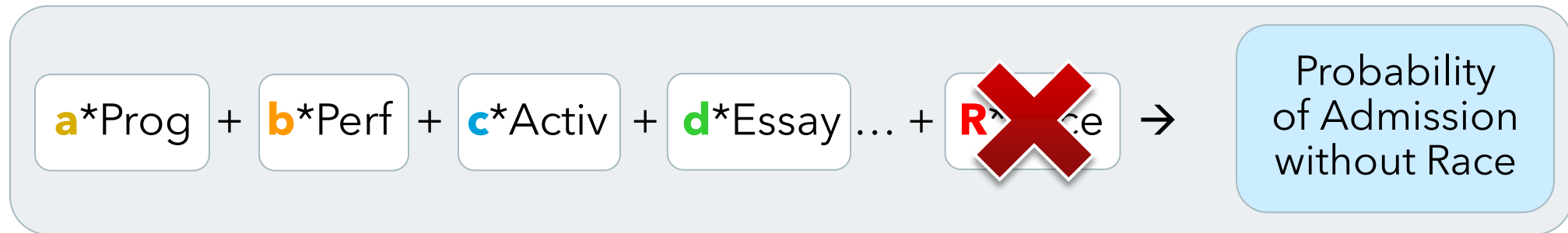
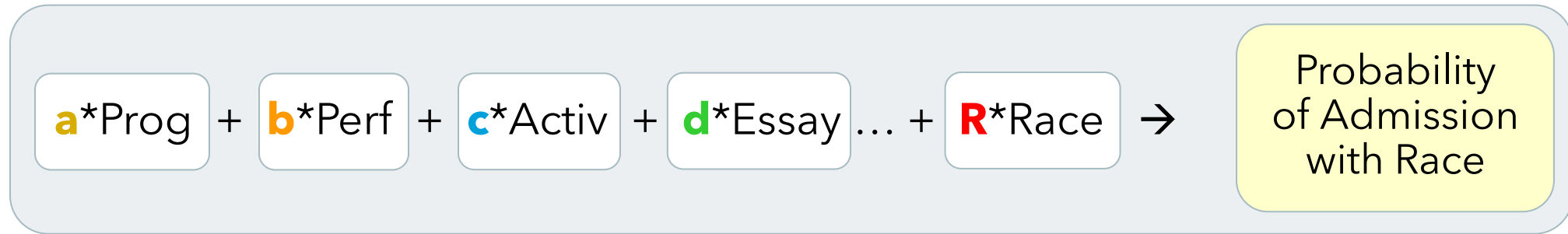
# Transformational Analysis: Changing the Race of an Individual Out-of-State Applicant

	Original Admit Probability	Admission probability if treated as <b>African American</b>	Admission probability if treated as <b>Hispanic</b>
<b>White</b> , Male, not FGC	10%	98.14%	69.05%
	25%	99.37%	87.00%
<b>White</b> , Female, not FGC	10%	98.28%	76.13%
	25%	99.42%	90.54%
<b>White</b> , Male, FGC	10%	93.23%	45.43%
	25%	97.64%	71.41%
<b>White</b> , Female FGC	10%	93.72%	54.34%
	25%	97.81%	78.12%

## Quantifying the Effect of UNC's Racial Preferences

Transformational Analysis	
Average Marginal Effect	
Admitted URM's Analysis	
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## Average Marginal Effect



$$\begin{array}{c} \text{Probability} \\ \text{of Admission} \\ \text{with Race} \end{array} - \begin{array}{c} \text{Probability} \\ \text{of Admission} \\ \text{without Race} \end{array} = \text{Marginal} \\ \text{Effect of Race}$$

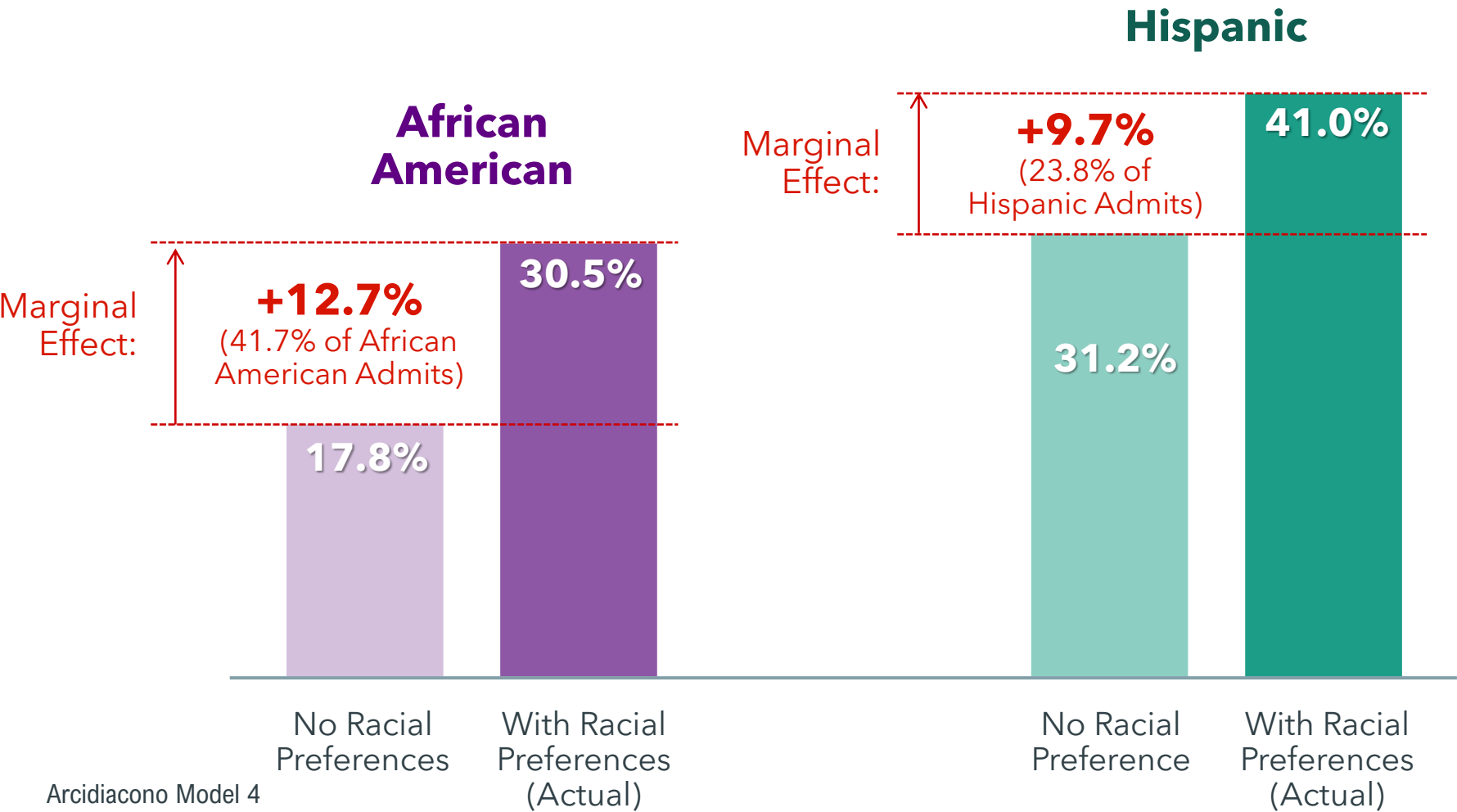
# Average Marginal Effect

## Average Admission Probability

In-State	With Racial Preferences	Without Racial Preferences	Marginal Effect of Race
<b>African American</b>	30.5%	17.8%	12.7%
<b>Hispanic</b>	41.0%	31.2%	9.7%

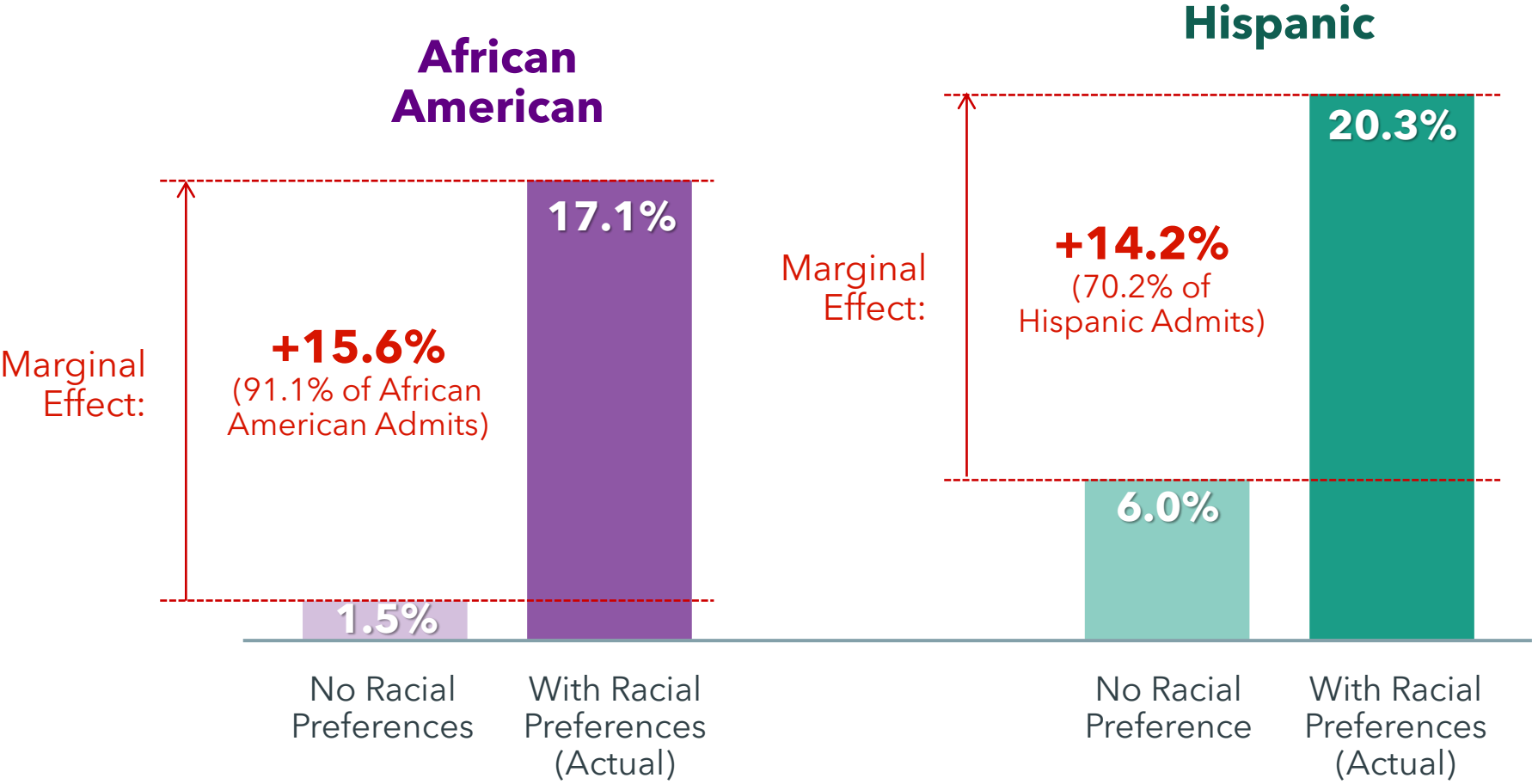
Out-of-State	With Racial Preferences	Without Racial Preferences	Marginal Effect of Race
<b>African American</b>	17.1%	1.5%	15.6%
<b>Hispanic</b>	20.3%	6.0%	14.2%

# Marginal Effect of Race/Ethnicity on Probability of Admission (In-State)





# Marginal Effect of Race/Ethnicity on Probability of Admission (Out-of-State)



# Racial Preferences by FGC Status



## Average Admission Probability

In-State	With Racial Preferences	Without Racial Preferences	Marginal Effect of Race
<b>African American</b> non-FGC	33.4%	18.4%	14.9%
<b>African American</b> FGC	26.1%	16.9%	9.3%
<b>Hispanic</b> non-FGC	45.8%	34.7%	11.0%
<b>Hispanic</b> FGC	35.5%	27.2%	8.3%

### Out-of-State

<b>African American</b> non-FGC	19.1%	1.6%	17.5%
<b>African American</b> FGC	11.9%	1.4%	10.5%
<b>Hispanic</b> non-FGC	22.1%	6.2%	15.9%
<b>Hispanic</b> FGC	13.7%	5.5%	8.2%

## Quantifying the Effect of UNC's Racial Preferences

Transformational Analysis	
Average Marginal Effect	
Admitted URM's Analysis	
Capacity Constraints Analysis	

## Determining the Effect of Racial Preferences for Admitted URMs

- Goal is to determine the probability that a URM who was admitted with UNC's racial preferences in place would still have been admitted if they instead had been treated as a white applicant.
- We can find this probability using Bayes' Rule:

$$\begin{aligned}\Pr(\textit{Admit NoPref}|\textit{Admit Pref}) &= \frac{\Pr(\textit{Admit NoPref}, \textit{Admit Pref})}{\Pr(\textit{Admit Pref})} \\ &= \frac{\Pr(\textit{Admit NoPref})}{\Pr(\textit{Admit Pref})}\end{aligned}$$

# Effect of Racial Preferences on Admitted Under-Represented Minorities

	<u>In-State</u>		<u>Out-of-State</u>	
	<b>African American</b>	<b>Hispanic</b>	<b>African American</b>	<b>Hispanic</b>
Average admit probability for previous admits	57.8%	75.8%	8.7%	29.2%
Share with greater than 50% drop	42.7%	21.9%	94.6%	78.4%

## Quantifying the Effect of UNC's Racial Preferences

Transformational Analysis	✓
Average Marginal Effect	✓
Admitted URM's Analysis	✓
Capacity Constraints Analysis	

## Capacity Constraint Methodology

- UNC has a limited capacity of available spaces for admitted students.
- Without racial preferences, URM admission probabilities decrease, which means fewer of those spaces are filled.
- Accordingly, each applicant's probability of admission must be adjusted upwards in order to reach the same number of admitted applicants as in the data.
- This is accomplished by increasing each applicant's admission index by the same amount until the average probability of admission matches that in the data.

# Capacity Constraints

## Change in Number of In-State Students by Race

	<b>White</b>	<b>Asian American</b>	<b>African American</b>	<b>Hispanic</b>
Number of Admits	18,865	3,223	2,374	1,470
No Racial Preference	19,889	3,370	1,532	1,212
Difference	<b>+1,024</b>	<b>+147</b>	<b>-842</b>	<b>-258</b>



# Capacity Constraints

## Change in Number of Out-of-State Students by Race

	<b>White</b>	<b>Asian American</b>	<b>African American</b>	<b>Hispanic</b>
Number of Admits	6,954	2,698	1,605	1,821
No Racial Preference	8,878	3,260	208	738
Difference	<b>+1,924</b>	<b>+562</b>	<b>-1,397</b>	<b>-1,083</b>

# Capacity Constraints

## Change in Number Students Overall

	<b>White</b>	<b>Asian American</b>	<b>African American</b>	<b>Hispanic</b>
In-State	<b>+1,024</b>	<b>+147</b>	<b>-842</b>	<b>-258</b>
Out-of-State	<b>+1,924</b>	<b>+562</b>	<b>-1,397</b>	<b>-1,083</b>
TOTAL	<b>+2,948</b>	<b>+709</b>	<b>-2,239</b>	<b>-1,341</b>

## Quantifying the Effect of UNC's Racial Preferences

Transformational Analysis	✓
Average Marginal Effect	✓
Admitted URM's Analysis	✓
Capacity Constraints Analysis	✓

# EXHIBIT 1 TABLE 1

## Analyzing UNC's Admissions Process: Race/Ethnicity as Additive Factors [1] All UNC Applicants, 2013-14 to 2016-17

	(A)	(B)	(C)	(D)	(E)= (B) x (A)	(F)= (C) x (A)
Row	Description of Specification [2]	R <sup>2</sup>	Share of R <sup>2</sup> due to combined test scores	Share of R <sup>2</sup> due to race/ethnicity	Share of R <sup>2</sup> due to variables other than race/ethnicity and combined test scores	Share of admission decision due to race/ethnicity
(1)	SAT Combined, ACT Comp [3] [4]	0.121	93.2%	6.8%	-	11.3%
(2)	(1) + SAT Subscores, ACT Subscores [3] [4] [5]	0.127	44.9%	7.0%	48.2%	0.9%
(3)	(1) + Class Rank, GPA	0.254	33.0%	3.5%	63.5%	0.9%
(4)	(3) + Sex	0.254	32.8%	3.5%	63.7%	0.9%
(5)	(4) + NC Resident	0.364	29.3%	2.8%	67.9%	1.0%
(6)	(5) + Min Coursework, HS Sport, Faculty / Staff Child	0.398	28.3%	2.8%	69.0%	1.1%
(7)	(6) + Alum Parent, Early Action	0.406	27.5%	3.0%	69.6%	1.2%
(8)	(7) + Parents' Education, Foreign Citizenship, Fee Waiver	0.409	26.9%	2.8%	70.2%	1.2%
(9)	(8) + Within-School GPA Rank (SGR)	0.428	23.0%	2.8%	74.2%	1.2%

Source: College Board; Connect Carolina; UNC Admissions Website

Note:

[1] This analysis uses Connect Carolina's pooled 2013-14 to 2016-17 data.

[2] Each specification includes race/ethnicity indicator variables.

[3] When a student has multiple SAT or ACT scores, the maximum subscores are utilized, both individually and in constructing the SAT combined score and the ACT comprehensive score.

[4] A new SAT test was introduced in 2016 and accepted during UNC's 2016-17 admissions cycle. UNC continues to accept the old SAT and the ACT. In the analysis here, new SAT scores are converted to old SAT scales. The new SAT math score is converted to the old SAT math scale using the 2008 College Board Concordance Conversion table. However, the new SAT verbal score can only be converted into the combined score of the old SAT reading and writing sections. An algorithm is used to determine the students' old SAT reading and writing subscores.

a) If the student only took the new SAT, the converted reading and writing scores are half the converted combined reading and writing score.

b) If the student took both the new SAT and the old SAT, then if the new converted SAT verbal score is less than the combined old reading and writing scores, the old scores are utilized. Otherwise, the difference between the new converted SAT verbal score and the combined old reading and writing scores (X) is added to the old reading score and the old writing score equally (X/2), unless this pushes an individual score over 800. In this case, this score is capped at 800 and the remaining amount of X is added to the other score. These adjusted old scores are then utilized.

[5] Both the SAT and ACT writing score are set to missing in 2016-17. In this admissions cycle, UNC stopped considering the writing section in the admissions process.

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## Professor McFadden on the Pseudo R Square Metric

“Those unfamiliar with the  $\rho^2$  index should be forewarned that its values tend to be considerably lower than those of the  $R^2$  index and should not be judged by the standards for a ‘good fit’ in ordinary regression analysis. For example, values of 0.2 to 0.4 for  $\rho^2$  represent an excellent fit.”

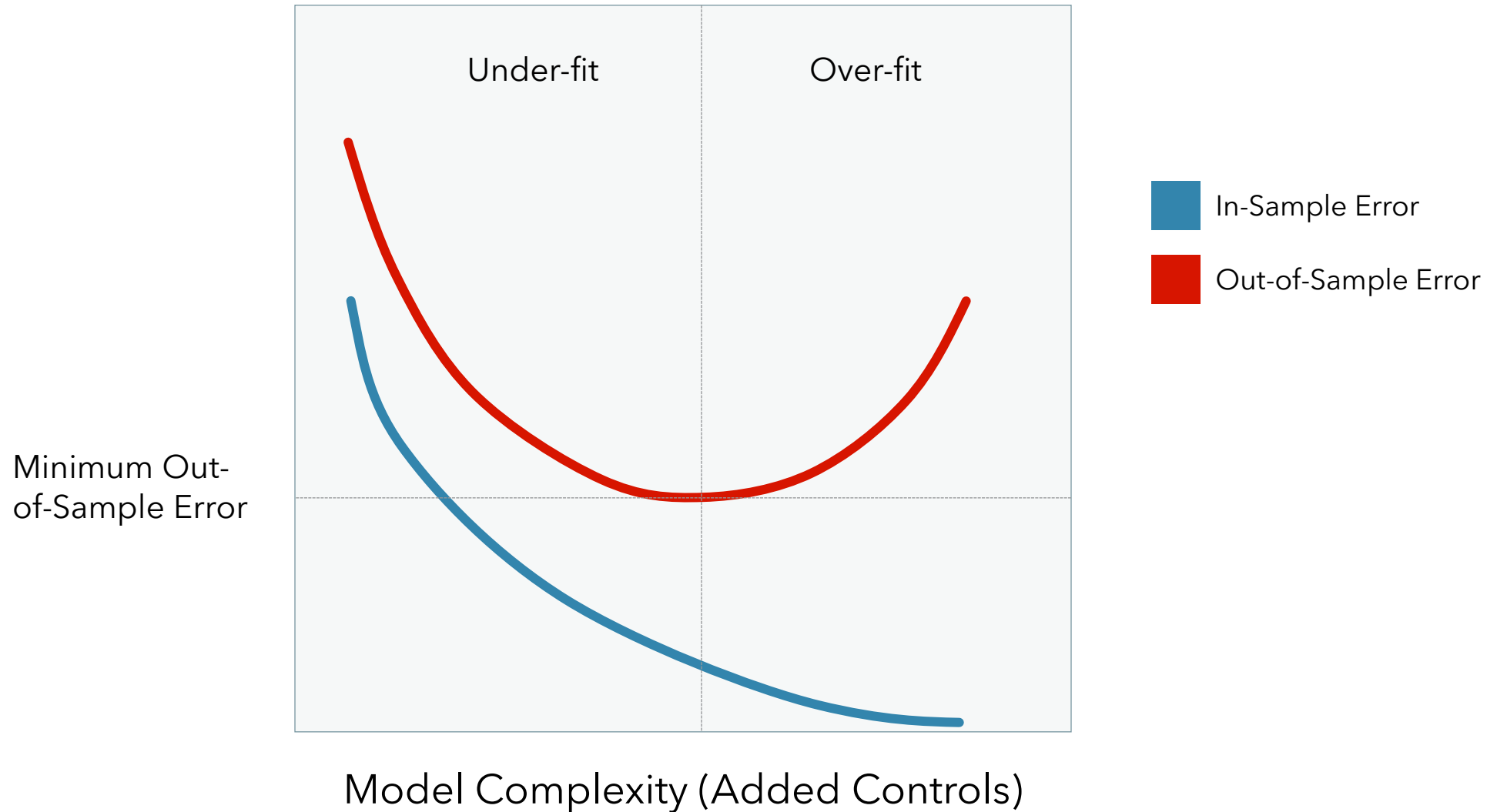
- D. McFadden, “Quantitative Methods for Analysing Travel Behavior: Some Recent Developments,” (Chapter 13 in Behavioral Travel Modeling, D.A. Hensher and P.R. Stopher, editors, Croom Helm Ltd., 1979.)

## Hoxby Overfit Methodology

- 1.** Uses only 3 of the 6 years of UNC applicant data.
- 2.** Estimates the models on one year of data; tests out-of-sample accuracy on other two.
- 3.** Uses mean squared error (MSE) to quantify in-sample and out-of-sample error.
- 4.** Evaluates overfit by dividing out-of-sample MSE by in-sample MSE.

# Model Error In and Out of Sample

*Model Error*



# Professor Hoxby's Overfit Measures for All of Her Additive Models

Hoxby Model	Increase in MSE, Out-of-Sample Relative to In-Sample	In-Sample MSE	Out-of-Sample MSE
1	1.51%	0.169	0.171
2	3.58%	0.167	0.172
3	3.40%	0.135	0.139
4	3.40%	0.135	0.139
5	4.53%	0.109	0.114
6	4.92%	0.106	0.111
7	5.04%	0.105	0.110
8	5.50%	0.105	0.110
9	5.01%	0.101	0.106



# Average Mean-Squared Error of Arcidiacono Models and Hoxby Model 9

<b>Arcidiacono In-State</b>		In-Sample	Out-of-Sample		In-Sample	Out-of-Sample	<b>Arcidiacono Out-of-State</b>
	Model 2	0.092	0.102	Model 2	0.072	0.084	
	Model 3	0.056	0.074	Model 3	0.046	0.063	
	Model 4	0.055	0.074	Model 4	0.045	0.063	
	Model 5	0.056	0.075	Model 5	0.061	0.077	
	Model 6	0.035	0.088	Model 6	0.037	0.104	
	Model 7	0.028	0.093				

		In-Sample	Out-of-Sample
<b>Hoxby</b>	Model 9	0.101	0.106

# Out-of-Sample Accuracy for Arcidiacono Models and Hoxby Model 9

**Arcidiacono  
In-State**

	Accuracy for Admits	Accuracy for Rejects	Overall Accuracy
Model 2	86.9%	87.9%	87.4%
Model 3	91.6%	92.2%	91.9%
Model 4	91.6%	92.2%	91.9%
Model 5	91.9%	91.9%	91.9%
Model 6	92.3%	92.4%	92.3%
Model 7	92.1%	91.8%	92.0%

**Arcidiacono  
Out-of-State**

	Accuracy for Admits	Accuracy for Rejects	Overall Accuracy
Model 2	62.2%	94.1%	89.8%
Model 3	74.9%	96.0%	93.2%
Model 4	75.1%	96.0%	93.2%
Model 5	76.2%	95.3%	92.2%
Model 6	74.9%	93.6%	90.6%

**Hoxby**

	Accuracy for Admits	Accuracy for Rejects	Overall Accuracy
Model 9	71.6%	89.9%	85.1%

# Including Special Recruiting Categories: Accuracy

		Pseudo R <sup>2</sup>		Overall Accuracy	
		In-State	Out-of-State	In-State	Out-of-State
	Model 3	0.715	0.584	91.8%	93.3%
	Model 3 including specials	0.688	0.522	91.8%	92.1%
	... plus special Indicator	0.732	0.640	92.4%	93.5%
	Model 2	0.565	0.416	86.9%	89.7%
	Model 2 including specials	0.556	0.352	87.3%	88.3%
	... plus special Indicator	0.593	0.496	87.8%	90.1%

Including Special Recruiting Categories: Coefficients

		Coefficient on <b>African American</b>		Coefficient on <b>Hispanic</b>	
		In-State	Out-of-State	In-State	Out-of-State
	Model 3	2.85	5.85	1.81	3.01
	Model 3 including specials	2.41	4.32	1.53	2.30
	... plus special Indicator	2.82	5.66	1.79	2.90
	Model 2	1.84	4.68	1.27	2.43
	Model 2 including specials	1.72	3.75	1.17	1.95
	... plus special Indicator	1.83	4.54	1.26	2.34

# Methods of Imputing Missing GPA

## **Model**

Interact Race  
with Missing GPA

## **Alternative Method 1:**

Assign Race-Specific Mean GPA

## **Alternative Method 2:**

Linear Regression to Impute  
Missing GPA (no race variables)

Comparison of High School GPA and Performance Rating by Race and Missing GPA Status

		Grade Point Average		In-State Performance Rating		Out-of-State Performance Rating	
		In-State	Out-of-State	GPA Present	GPA Missing	GPA Present	GPA Missing
Race	White	4.43	4.15	7.01	7.27	7.47	7.59
	Asian	4.47	4.17	6.56	7.54	7.17	7.33
	African American	4.08	3.84	5.42	5.59	5.70	5.85
	Hispanic	4.26	4.16	6.10	6.03	6.71	7.01

# Average Marginal Effects of Race Under Alternative Imputation Procedures for Missing Performance Measures

*Preferred*

*Impute 1*

*Impute 2*

**African American**

**African American**

**African American**

In-State

Out-of-State

In-State

Out-of-State

In-State

Out-of-State

Average Admission Probability  
with Racial Preferences

30.5%

17.1%

30.5%

17.1%

30.5%

17.1%

Average Admission Probability  
without Racial Preferences

17.8%

1.5%

17.4%

1.7%

17.9%

2.0%

Marginal Effect of Race

12.7%

15.6%

13.2%

15.4%

12.6%

15.1%

*Preferred*

*Impute 1*

*Impute 2*

**Hispanic**

**Hispanic**

**Hispanic**

In-State

Out-of-State

In-State

Out-of-State

In-State

Out-of-State

Average Admission Probability  
with Racial Preferences

41.0%

20.3%

41.0%

20.3%

41.0%

20.3%

Average Admission Probability  
without Racial Preferences

31.2%

6.0%

31.4%

5.9%

31.9%

6.3%

Marginal Effect of Race

9.7%

14.2%

9.6%

14.3%

9.0%

13.9%

# Average Marginal Effect of Race When Personal Quality Rating is Removed

	African American		Hispanic	
	In-State	Out-of-State	In-State	Out-of-State
Average Admission with Racial Preferences	30.5%	17.0%	41.0%	20.2%
Probability without Racial Preferences	17.6%	1.4%	30.9%	5.8%
Marginal Effect of Race	12.9%	15.7%	10.1%	14.5%



Average Marginal Effect of Racial Preferences: Hoxby Model 9

Average Admission Probability

	With Racial Preferences	Without Racial Preferences	Marginal Effect Average
African American	24.3%	11.7%	12.6%
Hispanic	27.9%	16.6%	11.2%

# Effect of Racial Preferences on Admitted Under-Represented Minorities Under Hoxby Preferred Model

Average Admit Probability for Previous Admits Share with greater than 50% drop	African American		Hispanic	
	In-State	Out-of-State	In-State	Out-of-State
	58.5%	32.4%	73.9%	49.8%
	36.9%	84.9%	12.7%	56.7%

Preferences African-American Applicants Received in Admissions  
Translated into SAT & GPA (as compared to white non-FGC)

		In-State		Out-of-State	
		SAT Points	GPA Points	SAT Points	GPA Points
Not FGC	Male	224	3.56	386	6.12
	Female	191	3.03	369	5.85
FGC	Male	249	3.94	414	6.56
	Female	216	3.42	397	6.29

\*Class of 2019